Editorial

The Wandering Roboteers...

Worldwide Impressions of an Evolving Technology

BY CARL HELMERS

Spring 1983 was an active and hectic travel time for me. As is usual for each spring for nearly a decade, I traveled twice to California. The first trip is always a round trip to the West Coast Computer Faire held in San Francisco, usually some time in March. The second trip is to join a shirt-sleeves gathering of designers, engineers, and researchers, sometime in April, under the auspices of a major engineering society. The complicating factor of this year's travels was an intermediate stop in Hannover, Germany. Now that this year's odyssey is over, I'll pass on some of the information I gathered in March and April.

Androbot and Topo-Logical Discoveries. I used the opportunity of my customary California trips to visit Androbot Inc. in Sunnyvale. I had first seen Androbot technology at a very hectic display in Las Vegas at the Consumer Electronics show last January. I wanted to visit Androbot's homeland to check on the progress of this new entry into the personal robotics field.

After the West Coast Computer Faire, my good friend Robert Tinney and I took a short side trip to Sunnyvale. Robert frequently does cover paintings for *Robotics Age* and other computer magazines. Our purpose was to visit Androbot and get to know what was happening. Our tour guide on this trip in April was Bill La, inventor of the incredible omnidirectional wheelchair (U.S. Patent #4,237,990). Bill works as an engineer for Androbot.

While at Androbot, we saw a bit of the future. The first major Androbot product to be readily available is the Topo version illustrated in these photographs and demonstrated in our recent visits to the factory. At the Winter Consumer Electronics Show in Las Vegas last January, Androbot had a big booth and demonstrated both Topo and a more elaborate version called B.O.B. (for Brain on Board). According to Nolan Bushnell, his goals with Androbot technology are to carry the technology of personal robots as far as possible.

The B.O.B. version, with its multiple processors and emulation of pet-like behaviors, will most likely be the first autonomous mass-produced robot. (As part of the Androbot engineering challenge, Nolan mentioned that Androbot is currently looking for a few mobile robot AI hackers with a good sense of practical implementation.) By the time you read this, we presume that the Androbot display at the Summer Con-

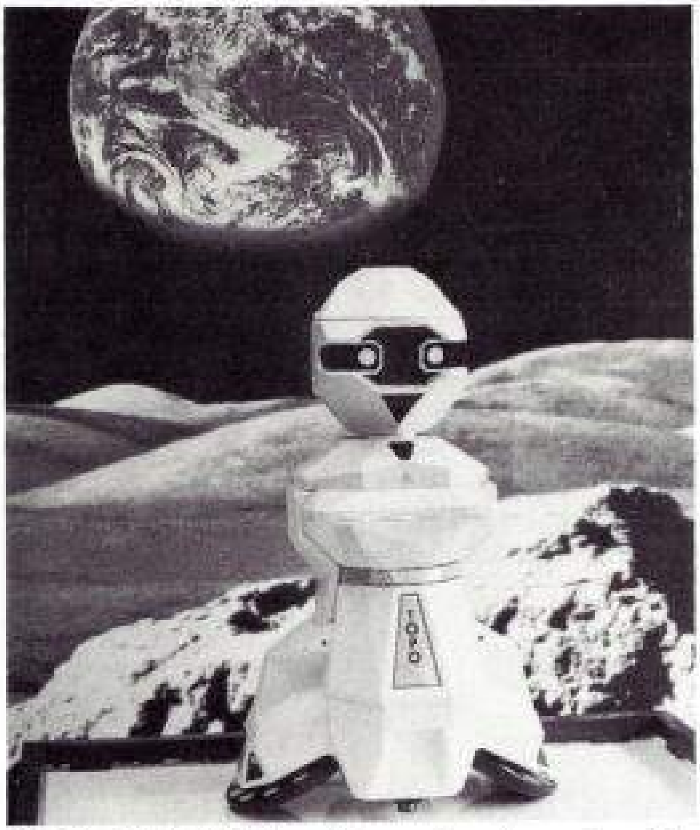

Photo 1. Androbot in full dress. Here we show a Topo version of the Androbot idea sitting in front of a wall mural on a lunar exploration theme.

Photo 2. Artist Robert Tinney, at the joystick control, exercises Topo. The Topo form of the Androbot product is an output-only peripheral for Apple-II and Apple-IIe computers. Topo appears to be examining Robert's actions, a neat trick if Topo could do it. (Topo has no sensors.)

Photo 3. Every laboratory has a workbench, and Androbot's are no exceptions. Here we see a random picture of one bench setup among many that were present at Androbot. Real engineers do use soldering irons, too.

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sumer Electronics Show in Chicago will have happened—including further demonstrations of the B.O.B. version. As of early May, the Topo version, with its Apple-II interface and optional LOGO software, is the most widely available form. This series of photographs will serve as a starting point for a continuing stream of information about one of the novel designs entering the personal robotics marketplace.

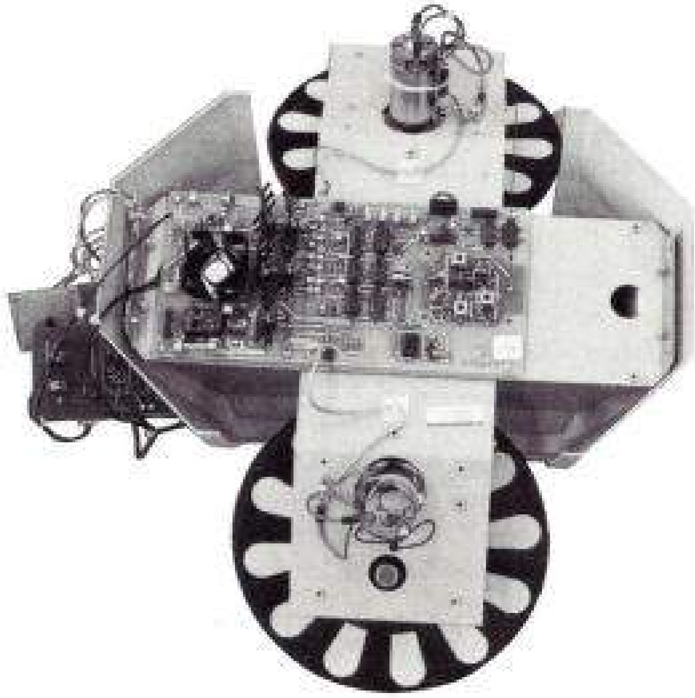

Photo 4. Removing a Topo's shell, we find the electronics of this simple personal robot. The electronics consists of a radio receiver, command decoding, and power drive electronics. Each wheel is individually commanded from the Apple computer, via the radio link. The joystick controls direction and relative speed of each wheel, giving its operator complete control of Topo's position. The receiver's antenna is a vertical whip extending upward within Topo's shell from a point near the right edge of the board in this photo. The batteries are mounted under the board, between the two wheels.

Photo 5. And more Topos (or B.O.B.s) are coming. As evidenced by this room full of shells, Androbot products are cranked out on a steady basis. One is tempted to compare this scene to images from the tale of the *Sorcerer's Apprentice*.

data was ruined, and serendipity saved the experiment.

Building a Safe Payload. Let us assume that you've paid your money and you're ready to begin turning your idea into hardware reality. What is the first step? The answer is simple: consult the *GAS User's Handbook*, available from NASA, and become familiar with the GAS ground rules. Simply stated, the rules define an elementary robotics situation:

- To conduct the experiment, GAS users are allowed three switches attached to a hand-held controller, to be operated by the shuttle crew members.
- One of these switches must be dedicated to an on/off function, while the others have unlimited capacity to do whatever can be programmed into them. Examples of switch uses are thermal controlling, opening an experiment to space, and data collection.
- Performance of the experiment must not take up any of the crew's time, with the exception of throwing the three switches on and off.
- The experiment must not be a threat to the safety of the other payloads, and most importantly, to the crew.

The potential GAS user is confronted with a multitude of questions such as, "What are the restrictions on GAS payloads?" and "What does a GAS user have to do to get a payload approved for flight?" The payload must have a scientific or technological objective. Although NASA will not concern itself with the scientific merit of any experiment, the program does not allow, for example, the inclusion of a batch of space artifacts such as "This Flew On the Space Shuttle" buttons, simply for resale as a commercial enterprise. Other restrictions on payloads are largely design considerations.

To get a GAS approved for flight, the user has to show only that it is safe. The complete responsibility for design and construction belongs to each user, and the individual must do this without the help of NASA, although NASA will advise, if necessary. A typical GAS payload will include a structure, some batteries, associated electrical wiring connected to an experiment, and a microprocessor to control execution of the experiment.

Some of the things the GAS user would have to do to qualify this payload are: build a structure strong enough to withstand the highest loads that could occur, incorporate a large factor of safety, and produce an adequate structural analysis in support of this; test the batteries for operation and outgassing in a variety of situations and show the results of this test; show that the battery container is adequate to prevent any danger if a battery cell should fail; produce all electrical circuits and show that adequate protective devices such as fuses are incorporated; produce a complete list of materials and their uses and show that any hazardous materials, such as mercury, are properly contained; do some thermal analysis to assess how much heat the payload will generate and that this heat can be adequately dissipated through a proper thermal design, and that such temperature sensitive items as batteries will not react in any hazardous fashion to any possible temperature rise or reduction.

All this sounds far more ominous than it really is, and with a good design, a GAS user can easily meet all these requirements. When the safety assessment has been approved, the experiment will be ready for final assembly.

Next Issue. Part 2 will discuss the actual flight preparations for a GAS payload. We will also explore some future uses of robots in space. □

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